

## Biocorrosion of Metals and Concrete

A wide range of environmental microbes thrive on the surface of metals and concrete. Their metabolic activities can affect these surfaces both negatively and positively. The negative effects include corrosion and

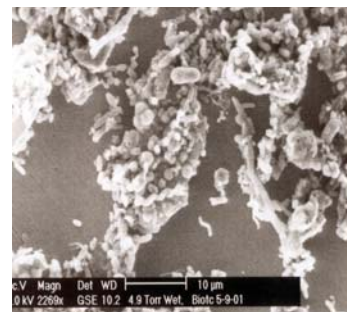
pitting. The positive effects include production of a biofilm on the materials surface thereby protecting it. These effects are observed in a range of infrastructure settings, e.g., power plants, roads, bridges, piping, metal containers, storage pool liners, etc.

INEEL biotechnology and materials scientists and engineers are beginning to understand and control these effects. Techniques and tools to define these naturally occurring microbes and their associated biofilms include scanning electrochemical microscopy, environmental scanning electron microscopy, atomic

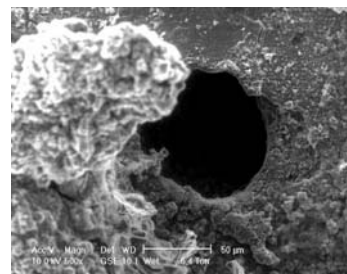
force microscopy, and molecular biology techniques to characterize the organisms and their metabolic products.

### PROGRESS

INEEL scientists have researched biocorrosion issues such as nuclear fuel storage pools, geothermal power plants,

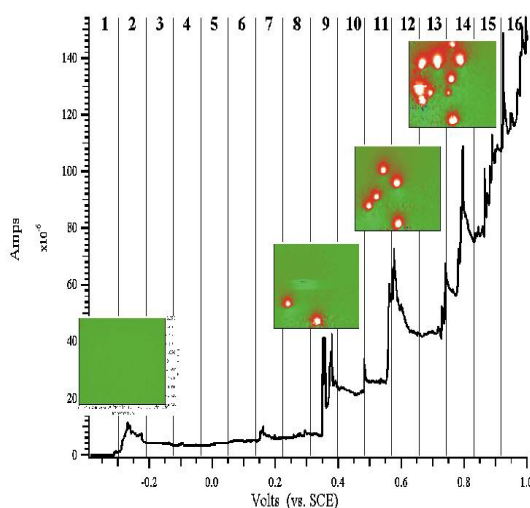


Microbes on metal surface ESEM



Biocorrosion pit ESEM

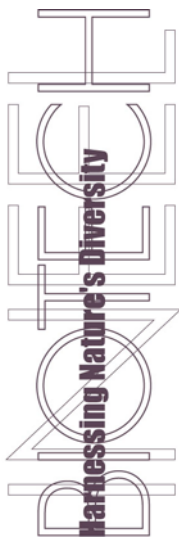
### Sample SRET Scan of Al6061-T6 in Sterile Conditions:



Measuring and visualizing metal surface biocorrosion process

concrete bridge and piping systems, and industrial sheet metal infrastructure items. Concerns driving the research range from deterioration of critical structures, to poor energy transfer, to environmental release of toxic materials.

Microbial growth in geothermal power plants is a common problem. Microbes and the associated biofilm interfere with energy transfer, and left untreated, lead to biocorrosion of the metal surfaces in these plants. Microbial monitoring aids in control of the biomaterials.



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The biocorrosion phenomenon has been put to beneficial use on the surfaces of radioactively contaminated concrete. Selected microbes are deployed on the

concrete where they produce an acid that gradually loosens the surface over a few weeks or months. This "biodecontamina-

tion" technique minimizes human exposure to ionizing radiation and reduces the cost of decontamination.

#### **Selected Publications/Presentations**

**P. J. Pinhero, T. E. Lister, C. S. Watkins, D. F. Bruhn, S. M. Frank**, "Localized Biocorrosion in Spent Nuclear Fuel Cladding Analogues," *EUROCORR 2001*, 2001.

**P. A. Pryfogle**, "Evaluation of Biological Measurement Methods Used at The Geysers," *Geothermal Resources Council Transactions*, Vol. 24, September 2000, pp. 24-27.

**M. A. Hamilton, R. D. Rogers, L. O. Nelson, R. G. Holmes, T. N. Milner**, "Biodecontamination: Cost-Benefit Analysis of A Novel Approach for Decontamination of Massive Concrete Structures," *Proceedings of Institution of Mechanical Engineers, National Meeting, Nuclear Decommissioning 98*, London, December 1998.

**M. A. Hamilton, R. D. Rogers, R. H. Veeh, M. Zolynski**, "Evaluation of Microbially-Influenced Degradation of Massive Concrete Structures," *Materials Research Society Symposium Proceedings 412*, 1996, pp. 469-474.